U. S. DEPARTMENT OF COMMERCE

BUILDING MATERIALS AND STRUCTURES

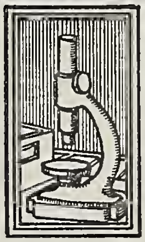
REPORT BMS23

Structural Properties of a Brick Cavity-Wall Construction Sponsored by the Brick Manufacturers Association of New York, Inc.

by

HERBERT L. WHITTEMORE
AMBROSE H. STANG, *and*
DOUGLAS E. PARSONS

NATIONAL
BUREAU OF STANDARDS



The program of research on building materials and structures, carried on by the National Bureau of Standards, was undertaken with the assistance of the Central Housing Committee, an informal organization of governmental agencies concerned with housing construction and finance, which is cooperating in the investigations through a subcommittee of principal technical assistants.

The Forest Products Laboratory of the United States Department of Agriculture is cooperating with both committees on investigations of wood constructions.

[For list of BMS publications and how to purchase, see cover page III]

UNITED STATES DEPARTMENT OF COMMERCE · Harry L. Hopkins, Secretary

NATIONAL BUREAU OF STANDARDS · Lyman J. Briggs, Director

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The National Bureau of Standards is a fact-finding organization; it does not "approve" any particular material or method of construction. The technical findings in this series of reports are to be construed accordingly.

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Foreword

This report is one of a series issued by the National Bureau of Standards on the structural properties of constructions intended for low-cost houses and apartments. Practically all of these constructions were sponsored by groups within the building industry which advocate and promote the use of such constructions and which have built and submitted representative specimens, as outlined in report BMS2, Methods of Determining the Structural Properties of Low-Cost House Constructions. The sponsor is responsible for the representative character of the specimens and for the description given in each report. The Bureau is responsible for the test data.

This report covers only the load-deformation relations and strength of the wall of a house when subjected to compressive, transverse, concentrated, impact, and racking loads by standardized methods simulating the loads to which the wall would be subjected in actual service. It may be feasible later to determine the heat transmission at ordinary temperatures and the fire resistance of this construction and perhaps other properties.

The National Bureau of Standards does not "approve" a construction, nor does it express an opinion as to the merits of a construction for the reasons given in reports BMS1 and BMS2. The technical facts on this and other constructions provide the basic data from which architects and engineers can determine whether a construction meets desired performance requirements.

Lyman J. Briggs, *Director.*

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CONTENTS

ABSTRACT

For the program on the determination of the structural properties of low-cost house constructions, the Brick Manufacturers Association of New York, Inc., submitted 15 specimens representing a brick cavity-wall construction.

The specimens were subjected to compressive, transverse, concentrated, impact, and racking loads. The compressive loads were applied to the facing and backing of three specimens and to the backing only of three other specimens. For each of the loads, three like specimens were tested. The deformation under load and the set after the load was removed were measured for uniform increments of load, except for concentrated loads, for which the set only was determined. The results are presented graphically and in a table.

I. INTRODUCTION

In order to provide technical facts on the performance of constructions which might be used in low-cost houses, to discover promising constructions, and ultimately to determine the properties necessary for acceptable performance, the National Bureau of Standards has invited the building industry to cooperate in a program of research on building materials and structures for use in low-cost houses and apartments. The objectives of this program are described in report BMS1, Research on Building Materials and Structures for Use in Low-Cost Housing, and that part of the program relating to the structural properties in report BMS2, Methods of Determining the Structural Properties of Low-Cost House Constructions.

As a part of the research on structural properties, six masonry wall constructions have been subjected to a series of standardized laboratory tests to provide data on the properties of some constructions for which the behavior in service is generally known. These data are given in report BMS5, Structural Properties of Six Masonry Wall Constructions. Similar tests have been made on wood-frame constructions by the Forest Products Laboratory of the United States Department of Agriculture, the results of which will be given in a subsequent report in this series.

This present report describes the structural properties of a wall construction sponsored by one of the groups in the building industry. The specimens were subjected to compressive, transverse, concentrated, impact, and racking loads, simulating loads to which the walls of a house are subjected. In actual service, compressive loads on a wall are produced by the weight of the roof, second floor and second-story walls if any, furniture and occupants, wind load on adjoining second-story walls, and

snow and wind loads on the roof. Transverse loads on a wall are produced by the wind, concentrated and impact loads by furniture or accidental contact with heavy objects, and racking loads by the action of the wind on adjoining walls.

The deformation and set under each increment of load were measured because the suitability of a wall construction depends in part on its resistance to deformation under load and whether it returns to its original size and shape when the load is removed.

II. SPONSOR AND PRODUCT

The specimens were submitted by the Brick Manufacturers Association of New York, Inc., New York, N. Y., and represented a brick cavity-wall construction. The specimens consisted of a brick facing and backing separated by an air space and connected by steel wall ties. The joints were cement-lime mortar.

III. SPECIMENS AND TESTS

The wall construction was assigned the symbol *BD*, and the specimens were assigned the designations given in table 1.

TABLE 1.—*Specimen designations, wall BD*

Specimen designation	Load	Load applied
C1, C2, C3	Compressive	Upper end, 3.12 in. from the inside face.
C1a, C2a, C3a	do	Upper end, on backing only, centered on backing.
T1, T2, T3	Transverse	Either face.
P1, P2, P3 [a]	Concentrated	Do.
I1, I2, I3	Impact	Do.
R1, R2, R3	Racking	Near upper end.

[a] These specimens were undamaged portions of the transverse specimens.

The specimens were tested in accordance with BMS2, Methods of Determining the Structural Properties of Low-Cost House Constructions, which also gives the requirements for the specimens and describes the presentation of the results of the tests, particularly the load-deformation graphs.

For the compressive load, three specimens were tested with the load applied to the facing and the backing, one-third the thickness of the specimens from the inside face, and three additional specimens with the load applied to the backing only, centered on the backing.

For the transverse, concentrated, and impact loads, only three specimens for each loading were tested, because the wall was symmetrical about a plane midway between the faces, and the results for loads applied to one face of the specimens should be the same as those obtained by applying the loads to the other face.

The tests were begun July 21, 1938 and completed September 16, 1938. The specimens were tested 28 days after they were built. The sponsor's representative witnessed the tests.

IV. WALL *BD*

1. SPONSOR'S STATEMENT

(*a*) *Materials*

Brick.—Clay brick, formed in sanded molds by the soft-mud process, and having frogs (depressed panels), 6 by 2 by ⅛ in., on one side, with the raised letters "SSBCO." The average dimensions were 8.09 by 3.65 by 2.30 in. (about 8 1/16 by 3 21/32 by 2 5/16 in). Sutton & Sudderly Brick Co., Coeymans, N. Y.

The following properties of the brick were determined by the Masonry Construction Section of the National Bureau of Standards. When laid, the brick were damp. The absorption for 1-min partial immersion was determined for two bricks taken about every 30 min from the mason's scaffold. The physical properties of the brick, determined in accordance with the American Society for Testing Materials Standard C 67–37,[1] are given in table 2.

TABLE 2.—*Physical properties of the brick, wall BD*

Compressive strength	Modulus of rupture	Water absorption						Weight, dry
		5-hr cold	24-hr cold, *C*	5-hr boil, *B*	Saturation coefficient, $\frac{C}{B}$	1-min partial immersion [a]		
						Dry	As laid	
*lb/in.*²	*lb/in.*²	*Percent*	*Percent*	*Percent*		*Grams/brick*	*Grams/brick*	*lb/brick*
3, 240	540	13. 4	13. 8	18. 7	0. 74	41	15	4. 13

[a] Immersed on flat side in ⅛ in. of water.

[1] Am. Soc. Testing Materials Supplement to Book of ASTM Standards, 78–82 (1937).

Mortar.—The materials for the mortar were Medusa Cement Co.'s "Medusa" portland cement, lime putty made by slaking Standard Lime and Stone Co.'s "Washington" powdered quicklime, and Potomac River building sand.

The mortar was 1 part of cement, 0.42 part of hydrated lime, and 5.1 parts of dry sand, by weight. The proportions by volume were 1 part of cement, 1 part of hydrated lime, and 6 parts of loose damp sand, assuming that portland cement weighs 94 lb/ft^3, dry hydrated lime 40 lb/ft^3, and 80 lb of dry sand is equivalent to 1 ft^3 of loose damp sand. The materials for each batch were measured by weight and mixed in a batch mixer having a capacity of 2/3 ft^3. The amount of water added to the mortar was adjusted to the satisfaction of the mason.

The following properties of the mortar materials and of the mortar were determined by the Masonry Construction Section. The cement complied with the requirements of Federal Specification SS–C–191a for fineness, soundness, time of setting, and tensile strength. The lime putty contained 40 to 45 percent of dry hydrate, by weight, and had a plasticity of over 600, measured in accordance with Federal Specification SS–L–351. The sieve analysis of the sand is given in table 3.

Table 3.—*Sieve analysis of the sand, wall BD*

United States Standard sieve No.	Passing, by weight
	Percent
8	100
16	88
30	53
50	9
100	1

The average water content of the mortar was 22.3 percent, by weight of dry materials. Samples were taken from at least one batch of mortar for each wall specimen, the flow determined in accordance with Federal Specification SS–C–181b, and six 2-in. cubes made. Three cubes were stored in water at 70° F, and three were stored in air near the wall specimen. The compressive strength of each cube was determined on the day the corresponding wall specimen was tested. The physical properties of the mortar are given in table 4.

Table 4.—*Physical properties of the mortar, wall BD*

Specimen	Flow	Compressive strength	
		Air storage	Water storage
	Percent	*lb/in.*^{2}	*lb/in.*^{2}
C1	106	598	658
C2	108	588	670
C3	111	668	776
C1a	115	586	703
C2a	101	544	660
C3a	108	592	617
T1	104	560	683
T2	112	699	751
T3	101	576	666
I1	103	540	700
I2	110	548	717
I3	108	653	744
R1	111	592	868
	115	541	830
R2		543	753
		558	792
R3	102	548	838
	105	425	745
Average	108	576	732

Wall ties.—Steel, ¼-in. diam, bent to a Z shape with 90° angles between the outstanding legs and the stem. The length of the stem was 6 in. and of the outstanding legs 3 in.

(*b*) *Description*

(1) *Four-foot wall specimens.*—The 4-ft wall specimens were 8 ft 2½ in. high, 4 ft 0 in. wide, and 9⅝ in. thick. The specimens were built with a brick facing, *A*, and backing, *B*, as shown in figure 1, separated by an air space, *C*, and connected by steel wall ties, *D*. There were 35 courses of brick in both the facing and the backing. Two wall ties, spaced 2 ft 0 in. on centers, were placed every sixth course starting with the joint between the third and fourth courses.

The bed joints were furrowed. The head joints were formed by applying the mortar cut from the bed joint at the face of the specimen to the outer edge of the brick and that from the cavity side to the bottom edge of the brick before placing. This resulted in solidly filled head joints.

The price of this construction in Washington, D. C., as of July 1937, was \$0.40/ft^2.

(2) *Eight-foot wall specimens.*—The 8-ft wall specimens were 8 ft 2½ in. high, 8 ft 1 in. wide, and 9⅝ in. thick. The specimens were similar to the 4-ft specimens. There were four wall ties, spaced 2 ft 0 in. on centers, placed every

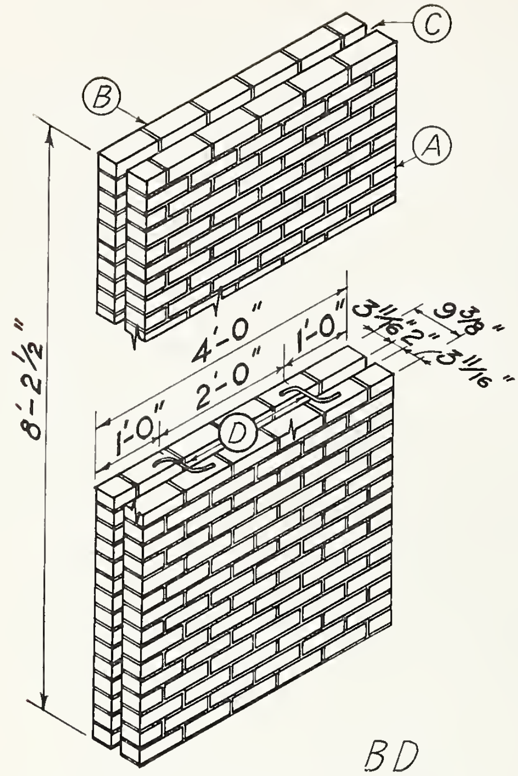


Figure 1.—*Four-foot wall specimen BD.*

A, facing; *B*, backing; *C*, air space; *D*, wall ties.

sixth course, starting with the joint between the third and fourth courses.

(*c*) *Fabrication Data*

The fabrication data, determined by the Masonry Construction Section, are given in table 5.

Table 5.—*Fabrication data, wall BD*

[The values per square foot were computed using the face area of the specimens]

Thickness of joints		Masonry units	Mortar materials			Mason's time
Bed	Head		Cement	Lime, dry hydrate	Sand, dry	
in. 0.52	*in.* 0.38	*Number/ft²* 12.1	*lb/ft²* 2.87	*lb/ft²* 1.21	*lb/ft²* 14.6	*hr/ft²* 0.183

(*d*) *Comments*

Brick cavity walls are widely used in Europe, especially in England, where cavity-wall construction is commonly used for brick walls.

Because the two sections of cavity walls are connected only by the small steel wall ties, any moisture which penetrates the facing will run down the inside of the facing. Consequently, provision must be made to catch this moisture at the bottom of the cavity or above openings,

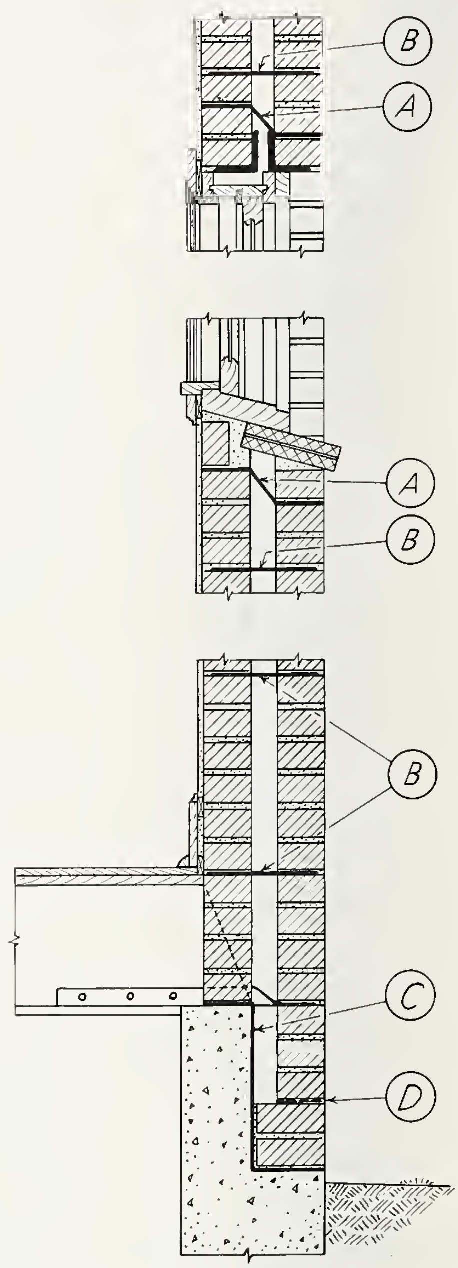


Figure 2.—*Flashing above and below windows, and dampproofing at bottom of cavity walls.*

A, flashing; *B*, wall ties; *C*, dampproofing; *D*, weep holes.

and deflect it outward. This is usually done by means of flexible dampproofing or flashing, as shown in figure 2. Weep holes or open joints may be provided to allow collected moisture to drain from the bottom of the cavity.

Furring, lath, and plaster, or other insulation or finish may be applied to the inside face of cavity walls in the same manner as to solid walls. It has not been considered good practice, however, to place insulation inside the cavity.

2. Compressive Load

(a) *Load on Facing and Backing*

Specimens *BD-C1*, *C2*, and *C3* were tested in accordance with BMS2. The compressive loads were applied to both the facing and the backing, 3.12 in. from the inside face.

Wall specimen *BD-C2* under compressive load is shown in figure 3. The results for wall specimens *BD-C1*, *C2*, and *C3* are shown in table 6 and in figures 4 and 5.

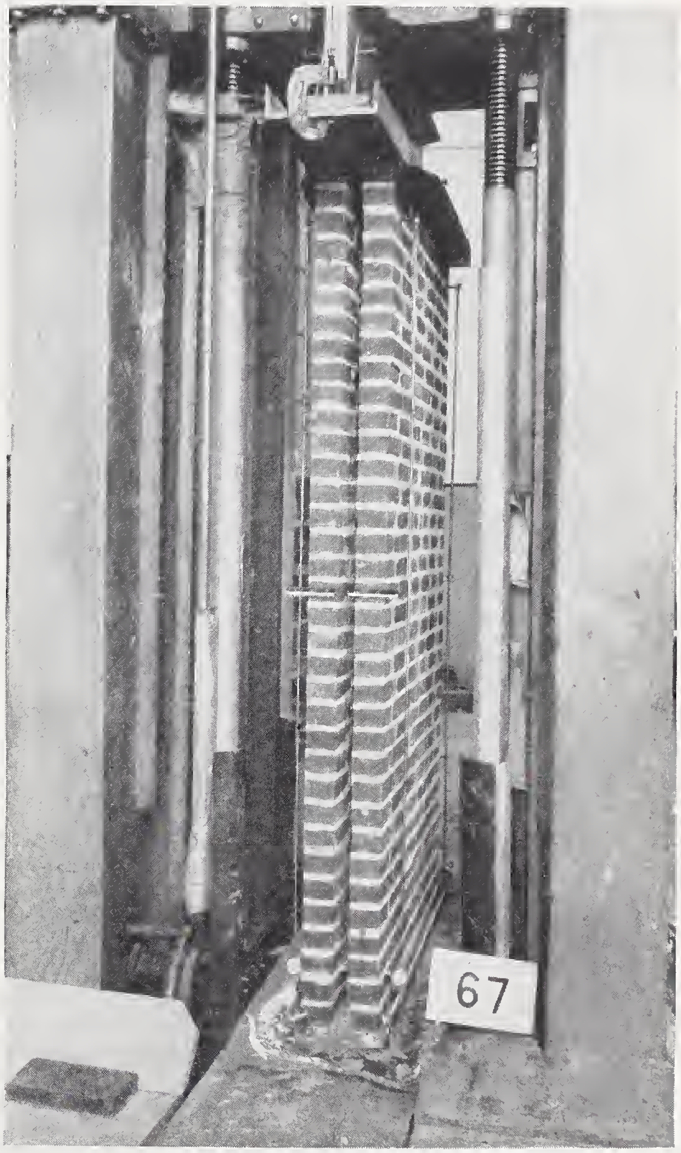


Figure 3.—*Wall specimen BD-C2 under compressive load, load applied to both facing and backing.*

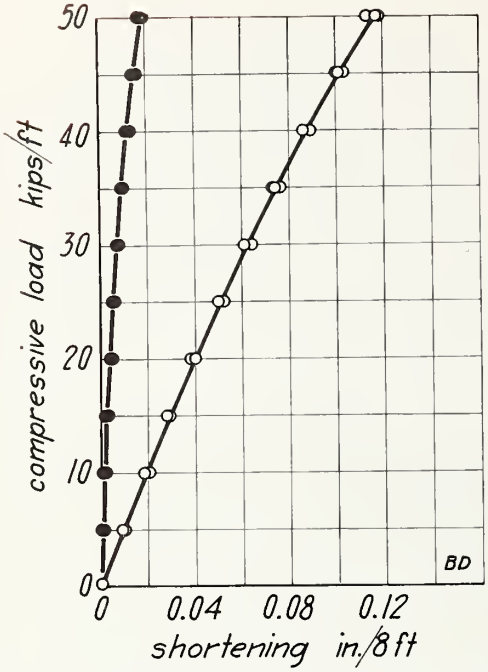


FIGURE 4.—*Compressive load on wall BD, load applied to facing and backing.*

Load-shortening (open circles) and load-set (solid circles) results for specimens *BD–C1*, *C2*, and *C3*. Load applied 3.12 in. from the inside face. The loads are in kips per foot of actual width of specimen.

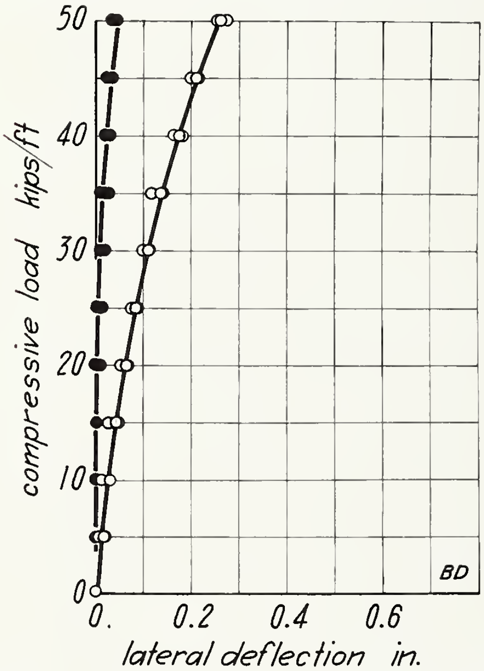


FIGURE 5.—*Compressive load on wall BD, load applied to facing and backing.*

Load-lateral deflection (open circles) and load-lateral set (solid circles) results for specimens *BD–C1*, *C2*, and *C3*. Load applied 3.12 in. from the inside face. The loads are in kips per foot of actual width of specimen. The deflections and sets are for a gage length of 7 ft 3 in., the gage length of the deflectometers.

TABLE 6.—*Structural properties, wall BD*

[Weight, 67.6 lb/ft²]

Load	Load applied	Specimen designation	Failure of loaded face, height of drop	Failure of opposite face, height of drop	Maximum height of drop	Maximum load
			ft	*ft*	*ft*	[a]*Kips/ft*
Compressive	Upper end, 3.12 in. from the inside face	*C1*				62.6
		C2				61.7
		C3				61.9
	Average					62.1
Do	Upper end on backing only, centered on backing	*C1a*				50.9
		C2a				48.3
		C3a				52.5
	Average					50.6
						lb/ft²
Transverse	One face; span, 7 ft 6 in.	*T1*				22.0
		T2				30.0
		T3				24.0
	Average					25.3
						lb
Concentrated	One face	*P1*				[b] 1,000
		P2				646
		P3				[b] 1,000
	Average					
Impact	One face; span, 7 ft 6 in.	*I1*	([c])	3.0	3.0	
		I2	1.5	2.5	3.5	
		I3	1.5	2.0	2.0	
	Average			2.5	2.8	
						[a]*Kips/ft*
Racking	Near upper end	*R1*				4.95
		R2				6.03
		R3				6.00
	Average					5.66

[a] A kip is 1,000 lb.
[b] Specimen did not fail. Test discontinued.
[c] There was a crack in the loaded face before the test.

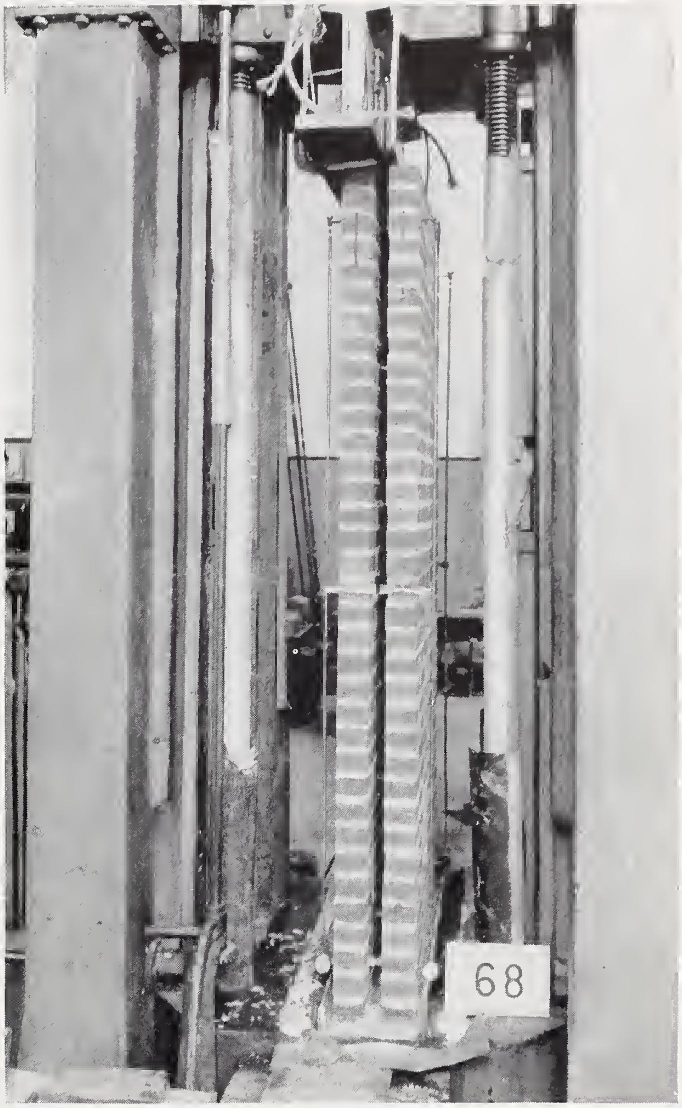
The shortenings and sets shown in figure 4 for a height of 8 ft were computed from the values obtained from the compressometer readings. The gage length of the compressometers was 7 ft 4 in.

Specimens *C1* and *C2* failed by crushing of the brick and the mortar bed joints in two or three courses of the backing at about two-thirds the height, followed by rupture of both backing and facing at this height. Specimen *C3* failed by crushing of a few bricks and the mortar bed joint in one course of the backing at about two-thirds the height.

(*b*) *Load on Backing Only*

Specimens *BD–C1a*, *C2a*, and *C3a* were tested in addition to the specimens required by BMS2. The compressive loads were applied to the backing only and centered on the backing.

Figure 6.—*Wall specimen BD–C1a under compressive load, load applied to backing only.*



This loading probably more nearly represents the load transmitted to the wall by the floor joists.

Wall specimen *BD–C1a* under compressive load is shown in figure 6. The results for wall specimens *C1a*, *C2a*, and *C3a* are shown in table 6 and in figures 7 and 8.

The shortenings and sets shown in figure 7 for a height of 8 ft were computed from the values obtained from the compressometer readings. The gage length of the compressometers was 7 ft 3 in.

Specimen *C1a* failed by crushing of a few bricks and the mortar bed joint in one course of the backing at about two-thirds the height, followed by rupture of both backing and facing. Specimen *C2a* failed by crushing of a few bricks in one course of the backing near the upper end of the specimen and cracking of the backing vertically at midwidth from about midheight to the upper end. Specimen *C3a* failed by crushing of one mortar bed joint of the backing at about two-thirds the height and cracking of the backing vertically.

3. Transverse Load

Wall specimen *BD–T3* under transverse load is shown in figure 9. The results for wall specimens *BD–T1*, *T2*, and *T3* are shown in table 6 and in figure 10.

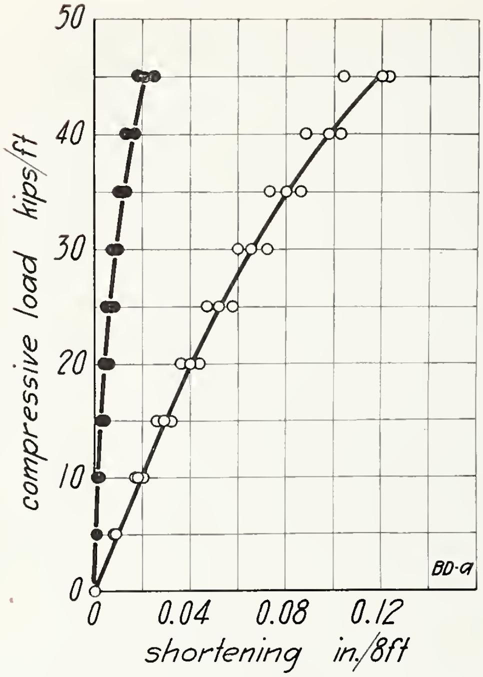


FIGURE 7.—*Compressive load on wall BD, load applied to backing only.*

Load-shortening (open circles) and load-set (solid circles) results for specimens *BD–C1a*, *C2a*, and *C3a*. Load centered on backing. The loads are in kips per foot of actual width of specimen.

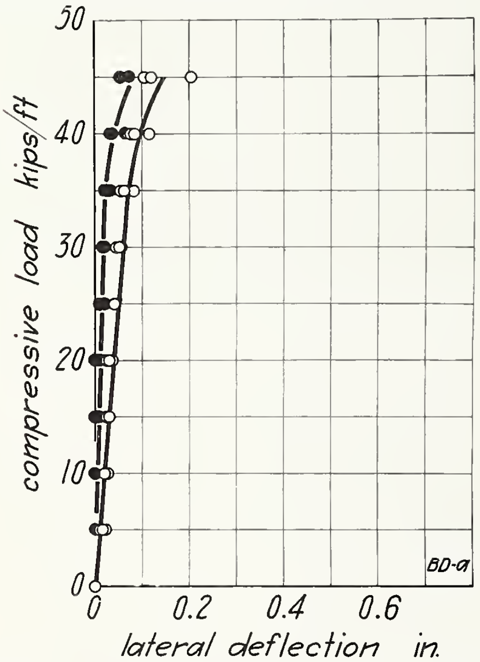


FIGURE 8.—*Compressive load on wall BD, load applied to backing only.*

Load-lateral deflection (open circles) and load-lateral set (solid circles) results for specimens *BD–C1a*, *C2a*, and *C3a*. Load centered on backing. The loads are in kips per foot of actual width of specimen. The deflections and sets are for a gage length of 7 ft 3 in., the gage length of the deflectometers.

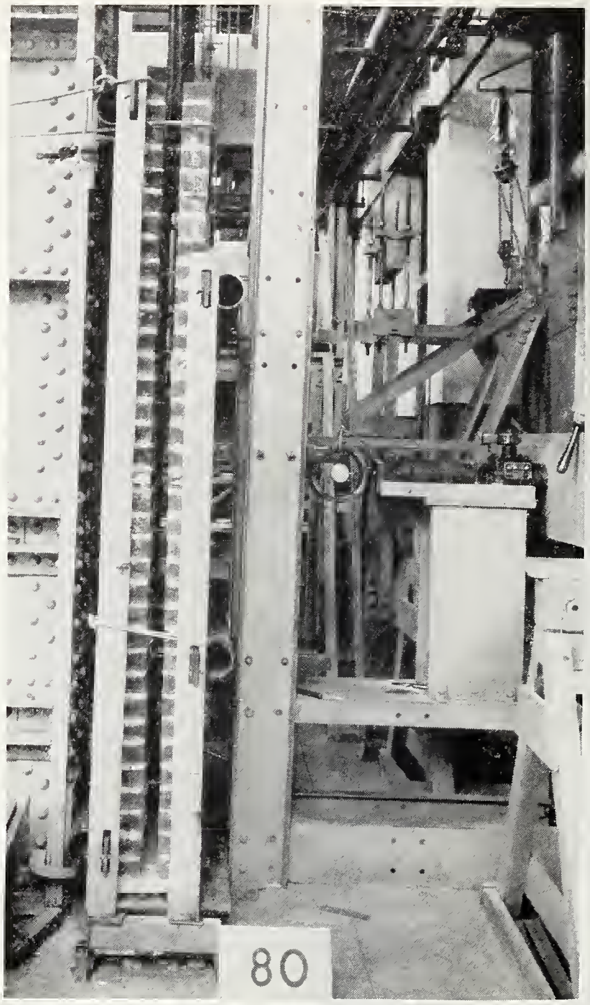


FIGURE 9.—*Wall specimen BD–T3 under transverse load.*

The deflections shown in figure 10 are the averages of the deflections of the loaded face and the opposite face, measured independently. The loaded face deflected the same amount as the opposite face within 0.01 in., the estimated error of measurement.

Each of the specimens failed by rupture of the bond between the brick and the mortar at one bed joint near a loading roller in both the loaded face and the opposite face. The rupture of the joint in the loaded face of specimen *T1* occurred at a joint having ties. The opposite face of specimen *T1* and both faces of specimens *T2* and *T3* failed at joints having no ties.

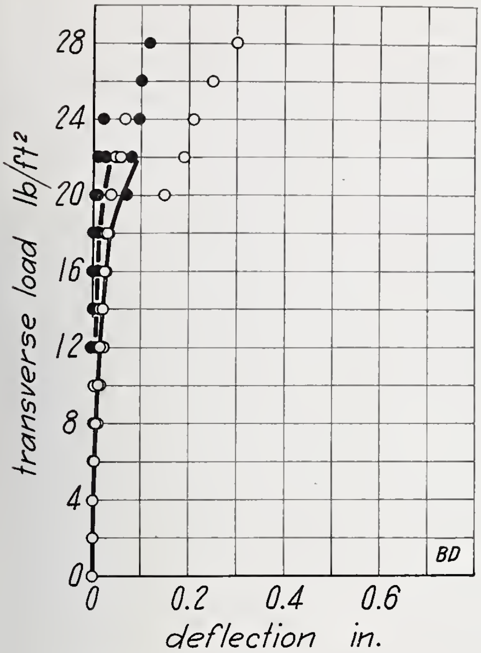


Figure 10.—*Transverse load on wall BD.*

Load-deflection (open circles) and load-set (solid circles) results for specimens *BD-T1*, *T2*, and *T3* on the span 7 ft 6 in. The deflections and sets are for a gage length of 7 ft 3 in., the gage length of the deflectometers.

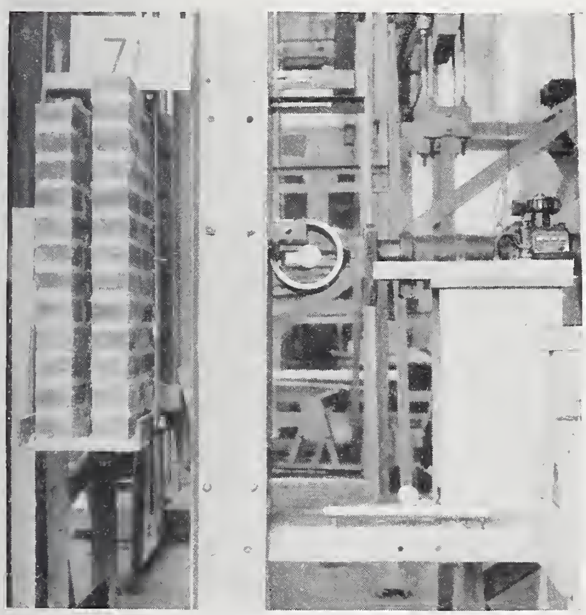


Figure 11.—*Wall specimen BD–P1 under concentrated load.*

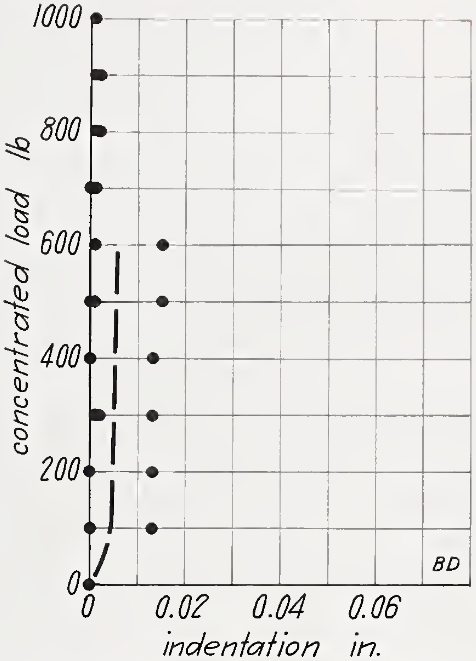


Figure 12.—*Concentrated load on wall BD.*

Load-indentation results for specimens *BD-P1*, *P2*, and *P3*.

4. Concentrated Load

Wall specimen *BD-P1* under concentrated load is shown in figure 11. The results for wall specimens *BD-P1*, *P2*, and *P3* are shown in table 6 and in figure 12.

The concentrated loads were applied to one face of each of specimens *P1* and *P2* at the center of the rectangle formed by four ties, the load being applied at the junction of a bed and a head joint for specimen *P1* and on a head joint for specimen *P2*. The concentrated loads were applied to specimen *P3* at midwidth on a brick in a course which was two courses above a bed joint having ties. The indentations after a load of 1,000 lb had been applied were 0.001 in. for specimens *P1* and *P3* and no other effect was observed. Specimen *P2* failed at a load of 646 lb by rupture of the bond between the brick and the mortar at the bed joint below the course to which the load was applied.

5. Impact Load

Wall specimen *BD–I3* under impact load is shown in figure 13. The results for wall specimens *BD–I1*, *I2*, and *I3* are shown in table 6 and in figure 14.

FIGURE 13.—*Wall specimen BD-13 under impact load.*

The impact loads were applied to the center of one face of each specimen, the sandbag striking the face between wall ties. Specimen *I1* had a crack in a bed joint in the loaded face at four-fifths the height before the test and, therefore, no set readings for this specimen were taken. This crack probably occurred when the specimen was moved to the impact equipment. No other cracks were observed in this face during the test. The opposite face of this specimen failed by rupture of the bond between the brick and the mortar at a bed joint two courses above the crack in the loaded face. For specimen *I2* at a drop of 1.5 ft, a bed joint near midheight in the loaded face cracked, and at 2.5 ft a bed joint three courses above in the opposite face also cracked. At the maximum drop the specimen failed by rupture of the bond between the brick and the mortar at the bed joints previously cracked. For specimen *I3* at a drop of 1.5 ft a bed joint at two-thirds the height in the loaded face cracked. At the maximum drop the specimen failed by rupture of the bond between the brick and the mortar at this joint and at a joint at the same height in the opposite face.

6. Racking Load

Wall specimen *BD–R2* under racking load is shown in figure 15. The results for wall specimens *BD–R1*, *R2*, and *R3* are shown in table 6 and in figure 16.

The deformations and sets shown in figure 16 for a height of 8 ft were computed from the measuring-device readings. The gage length of the vertical measuring device was 6 ft 4 in. The gage length of the horizontal measuring device was 5 ft 0 in.

Specimens *R1* and *R3* failed by rupture of both facing and backing approximately along a diagonal between the point of application of load and the stop. The cracks followed the joints in some places and passed directly through the brick in other places. Specimen *R2* failed by rupture of the backing only. The failure of the backing was similar to that for specimens *R1* and *R3*.

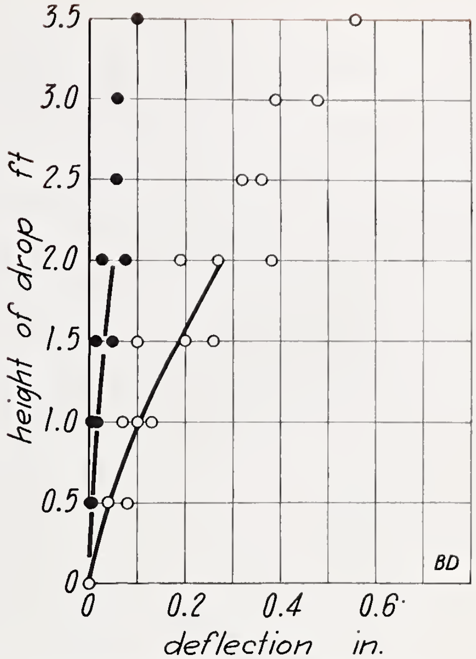


Figure 14.—*Impact load on wall BD.*

Height of drop-deflection (open circles) and height of drop-set (solid circles) results for specimens *BD–I1*, *I2*, and *I3* on the span 7 ft 6 in.

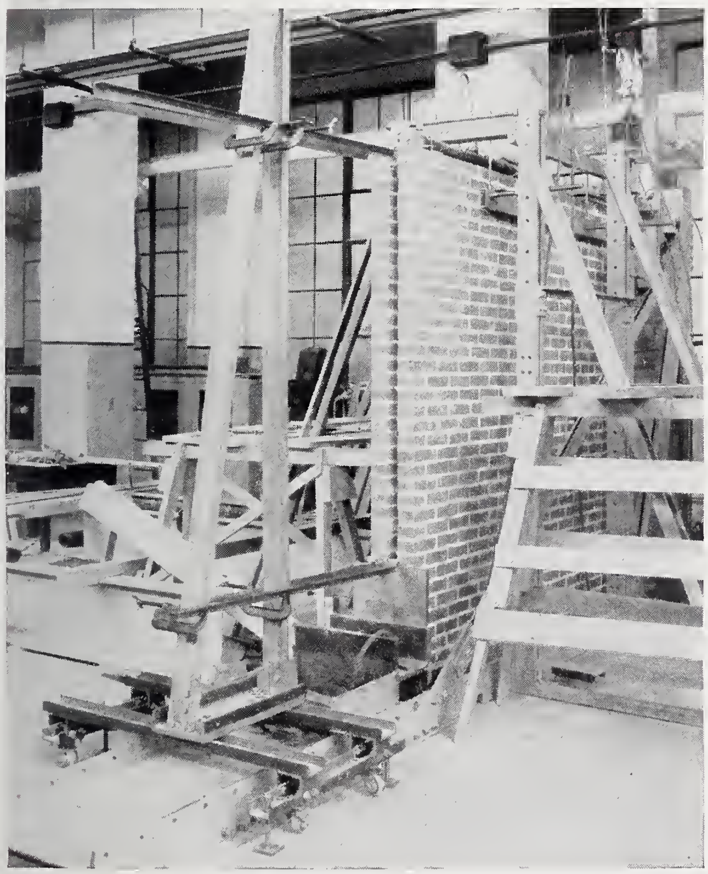


Figure 15.—*Wall specimen BD–R2 under racking load.*

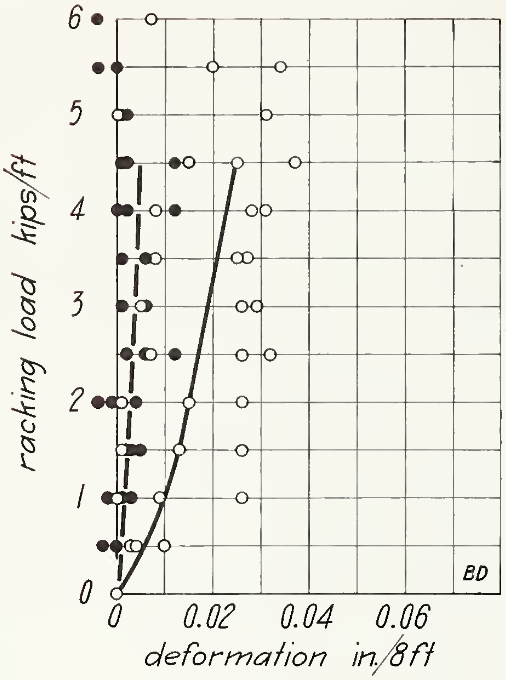


FIGURE 16.—*Radking load on wall BD.*

Load-deformation (open circles) and load-set (solid circles) results for specimens *BD-R1*, *R2*, and *R3*. The loads are in kips per foot of actual width of specimen.

The drawings of the specimens were prepared by E. J. Schell, G. W. Shaw, and T. J. Hanley of the Bureau's Building Practice and Specifications Section, under the supervision of V. B. Phelan.

The structural properties were determined by the Engineering Mechanics Section, under the supervision of H. L. Whittemore and A. H. Stang, and the Masonry Construction Section, under the supervision of D. E. Parsons, with the assistance of the following members of the professional staff: C. C. Fishburn, F. Cardile, R. C. Carter, H. Dollar, M. Dubin, A. H. Easton, A. S. Endler, C. D. Johnson, P. H. Petersen, A. J. Sussman, and L. R. Sweetman.

V. SELECTED REFERENCES

Edwin Gunn, *Survey of modern building techniques—domestic and similar structures*, Architect and Building News (London), **152**, 101–2 (1937).

Notes from the Information Bureau of the Building Research Station, Architect and Building News (London), **153**, 234 (1938); **156**, 199–200 (1938); Master Builder (London), p. 806 (Nov. 1938).

Leonard W. Burridge, *Weatherproof brickwork*, The British Clayworker, p. 119–31 (July 1938).

London County Council, Construction of Buildings in London, p. 22 and 28 (June 1938).

WASHINGTON, April 6, 1939.

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